

PSS to Beamline EPS ICD
E000P-911092-02
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Beamline Equipment Protection System Interface Control Document

FOR: _____
Beamline Number

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Revision Record

| <u>Revision</u> | <u>Dated</u> | <u>Comments</u> |
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| 00 | 03/07/96 | Initial Release. |
| 01 | 09/14/98 | Update and Clarification of Procedure and Terms. |
| 02 | 08/23/02 | Update |

Acronyms

The following are some of the frequently appearing or unique acronyms used in this document. This list is provided as a quick reference for the reader's convenience.

| | |
|-------------|---|
| ASD..... | Accelerator Systems Division |
| APS | Advanced Photon Source |
| BL..... | Beamline |
| ATPR..... | Acceptance Test Plan Reviews |
| DR | Design Reviews |
| EPS | Equipment Protection System |
| FE | Front End |
| FERDP | Front End Relay Distribution Panel |
| HDS | Hardware Development Section |
| ISDS | Interlock Systems Design Section |
| ISIG | Interlock Systems and Instrumentation Group |
| PSS | Personnel Safety Systems |
| SDP | Software Development Plan |
| SDS | Software Development Section |
| SRS..... | Software Requirements Specification |

1. INTRODUCTION

1.1 Purpose

This document explains the wiring whereby a beamline User can interface their Beamline Equipment Protection System (BLEPS) to the Advanced Photon Source Personnel Safety System (PSS). The primary responsibility of the User's BLEPS is to ensure that Beamline components are protected from damage or destruction by synchrotron radiation.

1.2 Scope

The PSS-BLEPS interface allows the User to provide to the PSS system integral shutter PERMITS, and receive back from the PSS system integral shutter STATUS. It also allows the User to receive beamline MODE STATUS. Integral shutters are defined as beamline shutters, downstream of the front end (PS1,PS2,SS1,SS2) shutters. The numbering of an integral shutter varies from beamline to beamline, with a general rule that lower numbers refer to devices closer to the front end. **It is important for the User to contact PSS to determine which STATUS or PERMIT number corresponds to a specific integral shutter.**

This document covers the termination of the PSS to BLEPS cable, for BLEPS Version 1 or Version 2 (defined in Background Section). Hence this document explains requirements for the User electronics for shutter PERMITS. This document gives typical designs for User electronics for display of shutter STATUS, and beamline MODE.

1.3 Applicability

This procedure applies to all of the beamlines. However there have been design changes to the PSS side of this interface. **It is important for the User to contact PSS to determine if their specific beamline runs a version 1 or a version 2 BLEPS.** In general beamlines built after November 2001 have version 2 BLEPS. Usually beamlines built before this date have version 1, but PSS personnel must verify this. The change involved added relay isolation between PSS power and the User.

1.4 References

Beamline PSS Validation Procedure

E000P-957085_Install_CheckOut_Val_PSS_BLEPS-xx.doc. Installation, Checkout, and Validation of the PSS-USER BLEPS System

ICD_PSS_to_RSC_E000P-912000. Interface Control Document Personnel Safety System to Beamline User Remote Shutter Control.

Generic Interface Control Document Front End Equipment Protection System to Beamline Equipment Protection System. Doc. No. E000P-911090.

1.5 Type of Procedure

This procedure is a description on an interface provided for the convenience of beamline Users. The interface work done by the Users will be validated upon installation. For this reason PSS maintains a standard termination at the User end of the cable (after this WAGO connector, responsibility for connections lies with the User). After this initial checkout, PSS personnel will not maintain the user side of this interface. PSS personnel will provide technical assistance, explanations of relevant component parts and some assistance testing the interface.

2. APPLICABLE DOCUMENTS

The following documents form a part of this specification to the extent specified herein.

2.1 APS Documents

Document No 1111-00001 APS Quality Assurance Plan, document dated May 1990.

2.2 Drawings

PSS-to-BLEPS Interface Diagrams
FERDP drawing package (2000000.dwg)
Other drawings labeled on figures.

2.3 Precedence

In the event of conflict between the provisions of the specification and other documents, the following precedence shall apply.

- This design specification.
- Documents referenced to the extent referenced herein.

3. BACKGROUND, VERSION 1, VERSION 2 BLEPS.

The PSS System relies on input from User electronics for front end and integral shutter permits, and generates output to the User electronics for shutter status. Since these inputs and outputs affect the PSS system, it is essential that the User properly adapt to PSS wiring. There are three shutter interfaces between the PSS/EPS system and the User:

- Front End Equipment Protection System (FE-EPS). This User-EPS interface is designed to allow the User to remotely provide PERMIT for Front-End shutters to open, and to remotely receive STATUS open/closed of FE shutters. A typical application would call for a separate User system to monitor the status of sensors for water flow, or vacuum pressure etc. These indications are summed (logical and) and provided as a FE-EPS PERMIT. From an ISIG/PSS/EPS point of view, this User system interfaces to the EPS system, and from there to the PSS system.
- Remote Shutter Interface. This User-PSS interface is designed to allow the User to open and close the front end shutters (the PS2/SS1/SS2 combination) as well as any desired integral shutters. The intent here is for User control, as opposed to monitoring, or permit. A standard application is allowing the User to open and close shutters in synchronization with an experiment. (Reference: ICD_PSS_to_RSC_E000P-912000-xx.doc. INTERFACE CONTROL DOCUMENT PERSONNEL SAFETY SYSTEM to BEAMLINE USER REMOTE SHUTTER CONTROL.)
- Beam Line Equipment Protection System (BLEPS)—this document. This User-PSS interface is designed to allow the User to remotely provide PERMIT for integral shutters to open, and to remotely receive STATUS open/closed of integral shutters and to receive MODE (white/pink/mono) information. BLEPS typically exists to ensure that Beamline components are protected from damage or destruction by synchrotron radiation. A typical application would call for the User BLEPS system to monitor the status of sensors for water flow, or vacuum pressure etc. These indications are summed (logical and) and provided as a BLEPS PERMIT for any integral shutter. Either Version 1 or Version 2 BLEPS may be present, with identical function, different wiring.

Version 1 BLEPS. In a Version 1 BLEPS interface, the User's control circuitry switches voltage coming directly from the PSS system power supplies. Hence it is essential that the User preserve the integrity of the voltage lines. In addition, the User must supply voltage.

Version 2 BLEPS. In a version 2 BLEPS interface, the User must supply voltage. The User is isolated from the PSS system power supplies.

4. OVERVIEW OF EQUIPMENT AND RESPONSIBILITIES

PSS-to-BL EPS or BL EPS-to-PSS signals for a beamline are as follows:

4.1 Segment 1 Beamline Shutter Permit

In general, logical 0/false equals clear, voltage low, 0 VDC. Logical 1/true equals set, voltage high, +24 VDC.

4.1.1 Description

This signal makes known to the PSS a BLEPS demand to close the most upstream Beamline integral shutter excluding the Front end Shutters. The most upstream beamline shutter may depend on the PSS Beam mode selected. If the *Segment 1 Beamline Shutter Permit* is cleared, the PSS will close the Segment 1 Beamline shutter. *Segment 1 Beamline Shutter Permit* is reset (set=1) upon achieving all conditions necessary to make the BLEPS ready to receive beam downstream of the Segment 1 Beamline Shutter. The Segment 1 Beamline Shutter is opened via the PSS.

4.1.2 Responsibility

The *Segment 1 Beamline Shutter Permits* are the responsibility of the BLEPS.

4.2 Segment 1 Beamline Shutter Closed

4.2.1 Description

This signal provides feedback about shutter position status (open/closed) to the BLEPS. If the Segment 1 Beamline Shutter is closed the signal is true (set=1), The PSS should update this signal only with the shutter in the full open/closed position. The shutter position status will be unique to the individual shutter and will always indicate open if the shutter is not installed in the beamline segment.

4.2.2 Responsibility

The *Segment 1 Beamline Shutter Closed* status signal is the responsibility of the PSS.

4.3 Segment 2 Beamline Shutter Permit

4.3.1 Description

This signal makes known to the PSS a BLEPS demand to close the Beamline integral shutter immediately downstream of the Segment 1 Beamline Shutter. If the *Segment 2 Beamline Shutter Permit* is cleared to 0, the PSS will close the Segment 2 Beamline shutter. *Segment 2 Beamline Shutter Permit* is reset (set=1) upon achieving all conditions necessary to make the BLEPS ready to receive beam downstream of the Segment 2 Beamline Shutter. The Segment 2 Beamline Shutter is opened via the PSS.

4.3.2 Responsibility

The *Segment 2 Beamline Shutter Permit* is the responsibility of the BLEPS

4.4 Segment 2 Beamline Shutter Closed

4.4.1 Description

This signal provides feedback about shutter position status (open/closed) from the PSS to the BLEPS. If Segment 2 Beamline shutter is closed the signal is true (set=1), otherwise it's clear. The PSS should update this signal only with the shutter in the full open/closed position. The shutter position status will be unique to the individual shutter and will always indicate opened if the shutter is not installed in the beamline segment.

4.4.2 Responsibility

The *Segment 2 Beamline Shutter Closed* status signal is the responsibility of the PSS.

4.5 Beam Mode Transition

4.5.1 Description

This signal if set (=1) informs the BLEPS that the beamline is being changed to another beam mode. This signal if clear (=0) informs the BLEPS that the beamline is in a valid PSS beam mode and has been properly reset.

4.5.2 Responsibility

The *Beam Mode Transition* signal is the responsibility of the PSS.

4.6 Beam Mode Type

4.6.1 Description

These two signals called Mode Logic “a” and Mode Logic “b” define the type of PSS beamline mode according to the following binary pattern:

(I) Mono beam is Mode Logic “a” is clear (=0) and Mode Logic “b” is clear (=0).

(ii) Pink beam is Mode Logic “a” is clear (=0) and Mode Logic “b” is set (=1).

(iii) White beam is Mode Logic “a” is set (=1) and Mode Logic “b” is clear (=0).

4.6.2 Responsibility

The *Beam Mode Type* signals are the responsibility of the PSS.

5. EXAMPLES

These examples are meant as illustrations of how some sectors have used BLEPS. No new interface specifications are included.

5.1 This scenario is taken from a sector BLEPS.

Beamline Status Condition:

- All FE and Beamline valves and shutters are open.
- Beamline is in mono beam mode.
- All vacuum sensors and controller inputs are within limits.

Alarm Condition:

Mirror temperature trip develops downstream of Shutter C (Segment 2 Beamline Shutter).

BLEPS Action:

The BLEPS demands the PSS to close upstream Segment C Shutter C (Segment 2 Beamline Shutter) by clearing *Segment C Interlocks OK* (Segment 2 Beamline

Shutter Permit) (clear=0, false). If within a specified time period the feedback signal, *Segment C Shutter Closed* (Segment 2 Beamline Shutter Closed)(set=1) is received, no further action is required by the BLEPS. Valves can be opened/closed downstream of the shutter from the BLEPS panels.

The BLEPS will request the PSS to close the next upstream shutter if not within a specified time period. Again, the BL EPS demands the PSS to close upstream Station A Shutter by clearing *Station A Interlocks OK* (*Segment 1 Beamline Shutter Permit*) (clear=0, false). If within a specified time period the feedback signal, *Station A Shutter Closed* (set=1) is received, no further action is required.

If the next shutter happens to be the FE shutters, the BLEPS clears the *Beamline Interlocks* (clear=0, false). This lets the FE EPS know that the beamline has an alarm condition and requires the FE EPS to close the FE shutters. The BL EPS looks for a returned status that the FE shutters have closed (set=1).

5.2 This scenario is taken from a sector BLEPS.

Beamline Status Condition:

- All FE and Beamline valves and shutters are open.
- Beamline is in white beam mode.
- All vacuum sensors and controller inputs are within limits.

Alarm Condition:

Vacuum leak detected by the White Beam Fixed Stop vacuum controller.

BLEPS Action:

Note: Experiments, conducted in BM Station B using White Beam, require the absorber and stop to be in the down and up position respectively, and locked (Kirk Key).

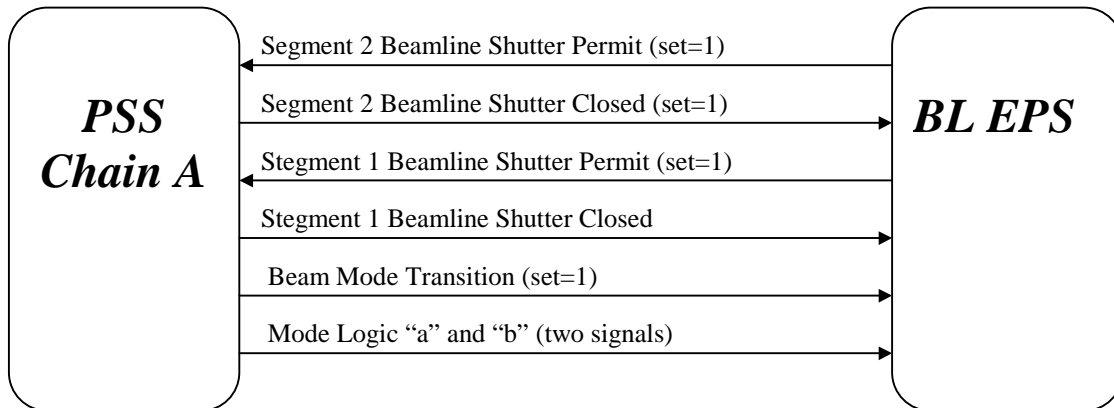
Since the shutter in Station A (i.e. Segment 1 shutter) is locked during white beam operations. The next upstream shutter is the FE shutter. The BLEPS clears the *Beamline Interlocks OK* (clear=0) signal. This informs the FE EPS that the beamline demands the FE shutters to be closed. The BLEPS looks for a return status that the *FE shutters are Closed* (set=1). With FE shutters closed, the VAT valve downstream of the fixed stop is closed. Upstream there is a window. The BL EPS takes no further action.

Note: The BLEPS system prevents the closed VAT valve, isolating the leak, from opening. Beamline vacuum conditions must be restored before the valve can be opened.

6. INTERFACE CHARACTERISTICS

6.1 Mechanical interface – cable and connectors.

The interface cable is terminated at the PSS rack using DIN rail-mounted WAGO terminal blocks. The interface cable is a 25 conductor, 20 AWG, foil shield Alpha No. 45470/25. This cable is classified as Power Limited Tray Cable (PLTC). Tray cable is a factory assembled multi-conductor control, signal, or



power cable specifically approved under the National Electrical Code (NEC) for installation in cable trays. The interface cable is terminated at the User end by a WAGO 231-112/026-000 connector. (Before 2001, the cable termination connector was unspecified.)

The cable is installed by PSS upon request from User. There are various WAGO connectors that can mate to the WAGO 231-112/026-000. Some are stocked by PSS and can be provided to the User.

6.2 Electrical/Electronic Interface – PSS side.

All interface signals shall utilize +24VDC voltage level. The electrical interface at the PSS Front End Distribution Relay Panel (FERDP) is given for BLEPS Version 1 (Fig 1) and BLEPS Version 2.(Fig 2).

6.2.1 Version 1 BLEPS. All PSS to User BLEPS signals shall be relay isolated: PSS PLC outputs drive relay coils. The contacts of these output relays close the STATUS or MODE circuits through the User power supply. The main interface cable shall be protected against dead shorts to ground by fusing either the individual cable or at the DC distribution bus.

6.2.2 Version 2 BLEPS. All PSS to User BLEPS signals shall be relay isolated: PSS PLC outputs drive relay coils. The contacts of these output relays close the STATUS or MODE circuits on the User power supply. Inside the PSS rack, all User BLEPS to PSS are relay isolated: User switch

closure (or PLC output etc) drives PSS relay coils. The contacts of these contacts close PSS Chain A power to PSS Chain A PLC.

6.3 Electrical/Electronic Interface—User Side.

The User must provide a voltage source, typical output current 1 amp. Outputs drive relay coils and inputs use dry contacts rated for 24VDC operations at roughly .1 amps.

The electrical schematic of the cable termination is given. (Fig 3 – BLEPS CABLE USER TERMINATION RENUMBERED.dsn). Not all pins on the 12 pin WAGO connectors are used. (Before 2001, the cable termination connector was unspecified.)

6.3.1 VERSION 1 BLEPS. To enable the PERMIT, the User must close relay contacts between the PSS RETURN signal and the proper PERMIT signal. A typical acceptable schematic is given (FIG 4, BLEPS_PSS_WIRING_USER-A.dsn)

These RETURN lines on both connectors are connected to the PSS +24 VDC power supply. It is important that the User isolate this power, and to maintain integrity by not allowing contact to chassis or ground.

6.3.2 VERSION 2 BLEPS. To enable the PERMIT, the User must supply +24 VDC to close PSS relays. A typical acceptable schematic is given. (Fig 5, BLEPS_PSS_WIRING_USER-Ver2.dsn)

7. SAFETY CONSIDERATIONS

7.1 Voltage

Low voltage (+24Vdc) circuitry is used.

7.1 Fail-Safe

By using a normally open (NO) set of contacts, the system (version 1 or version 2) is inherently fail-safe to faults such as loss of power or disconnected cables.

Fig 1. BLEPS Version 1 Wiring at the PSS side.

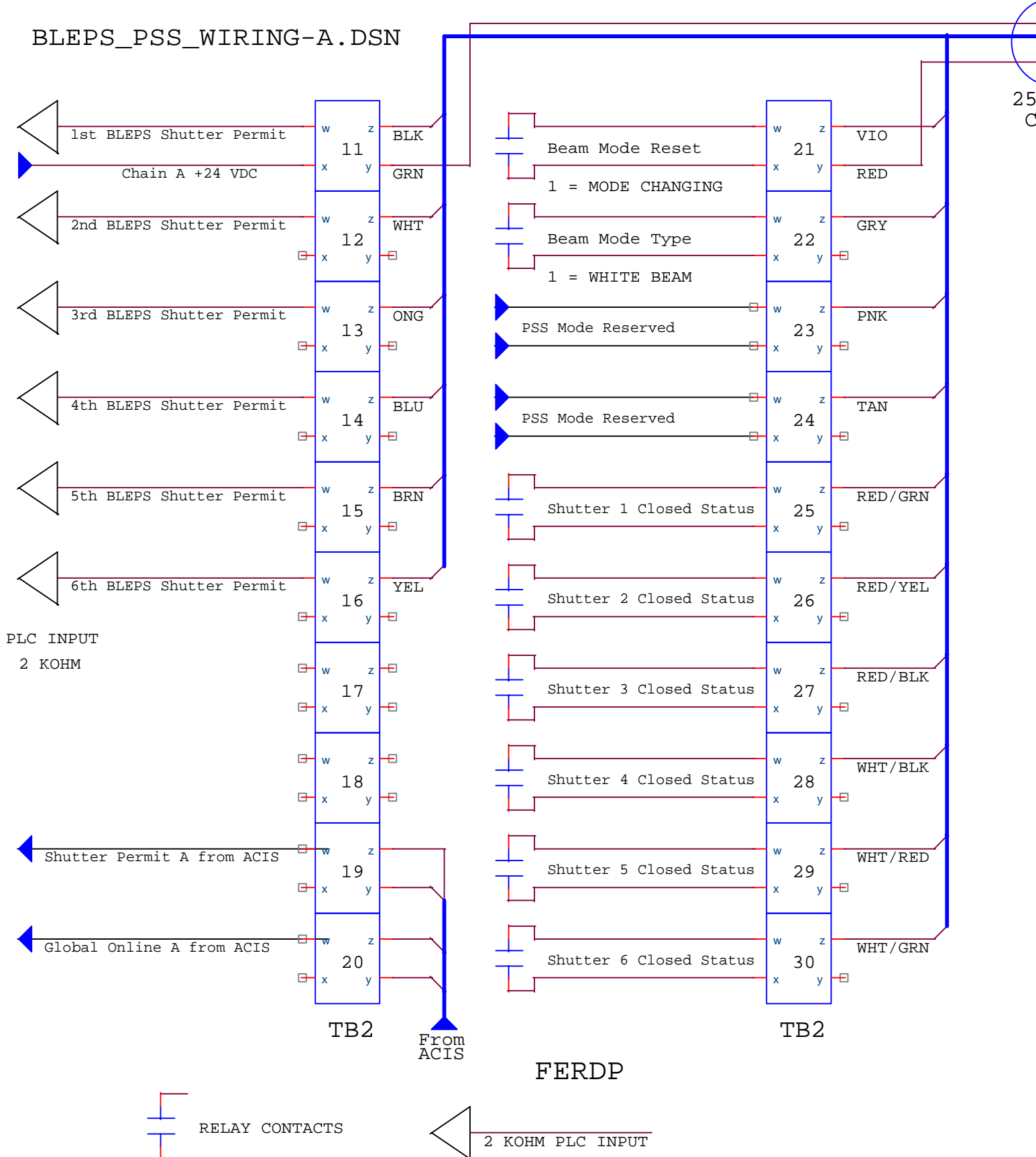
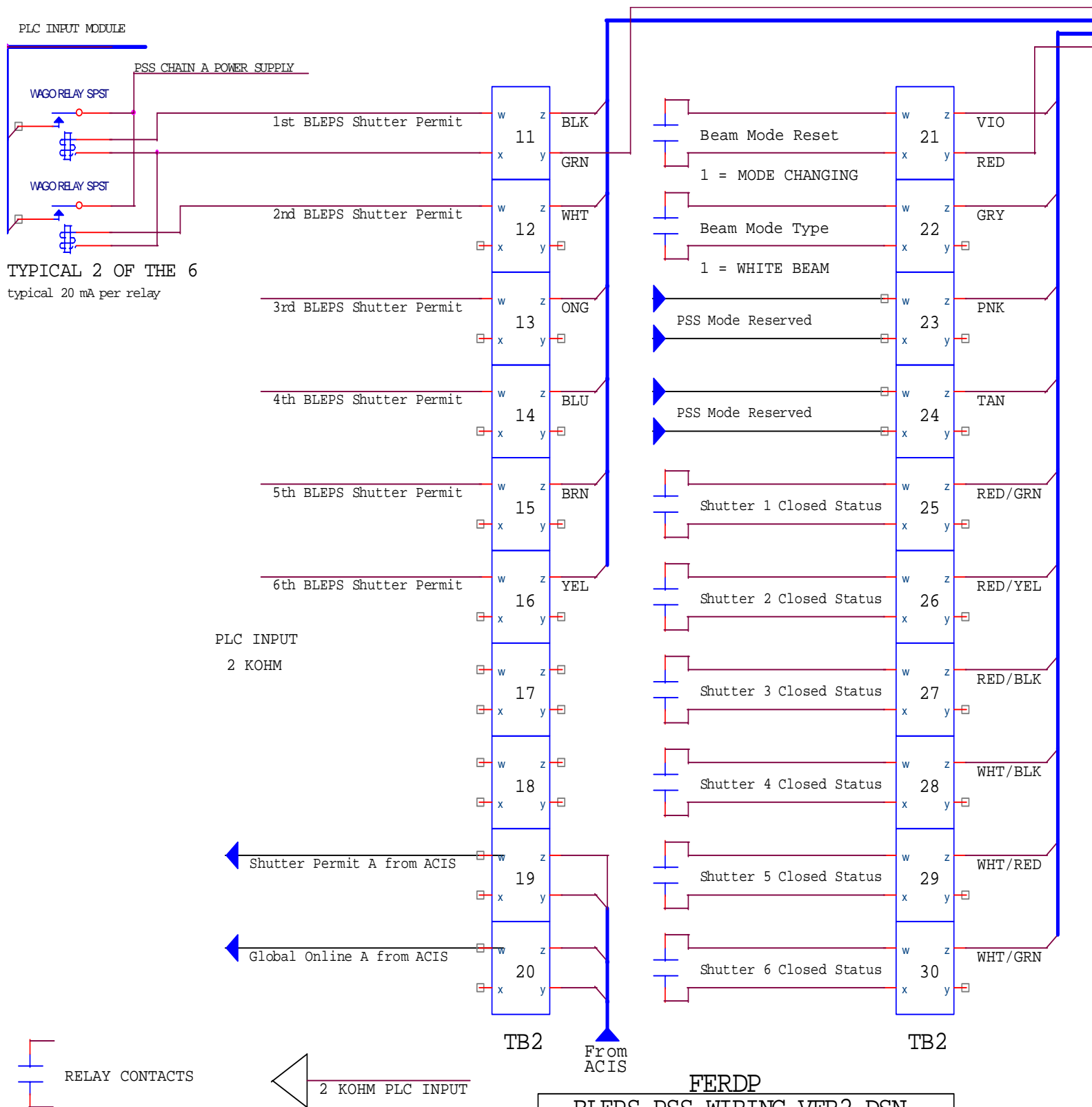


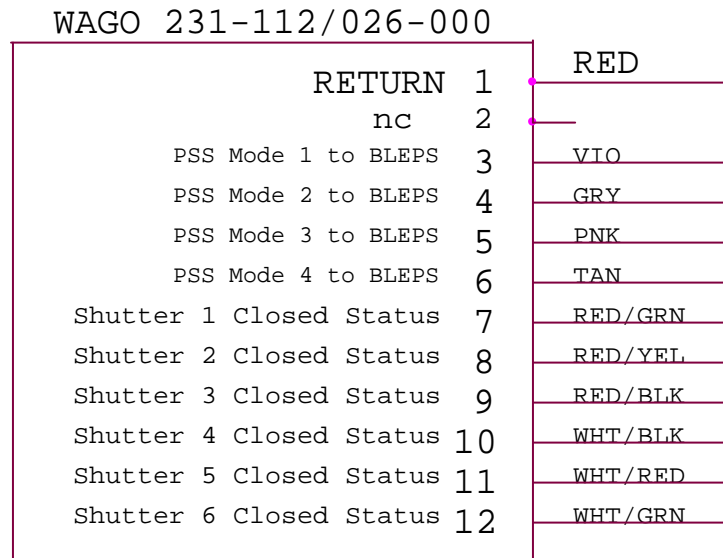
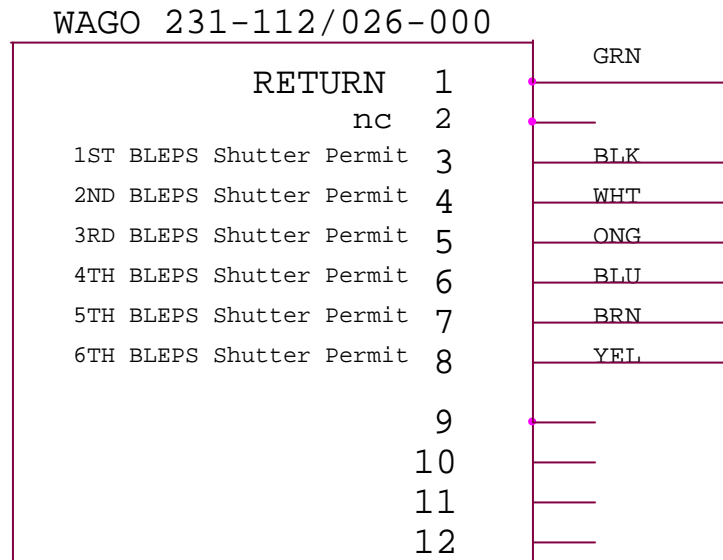
Fig 2. BLEPS Version 2 wiring at the PSS side.



| BLEPS PSS WIRING-VER2.DSN | | |
|----------------------------------|-----------------|------------|
| Title | | |
| (Title) SR/DF 1/2002 | | |
| Size | Document Number | Rev |
| C | (Doc) | (Rev/Date) |
| Date: Thursday, January 24, 2002 | | |
| Sheet 1 of 1 | | |

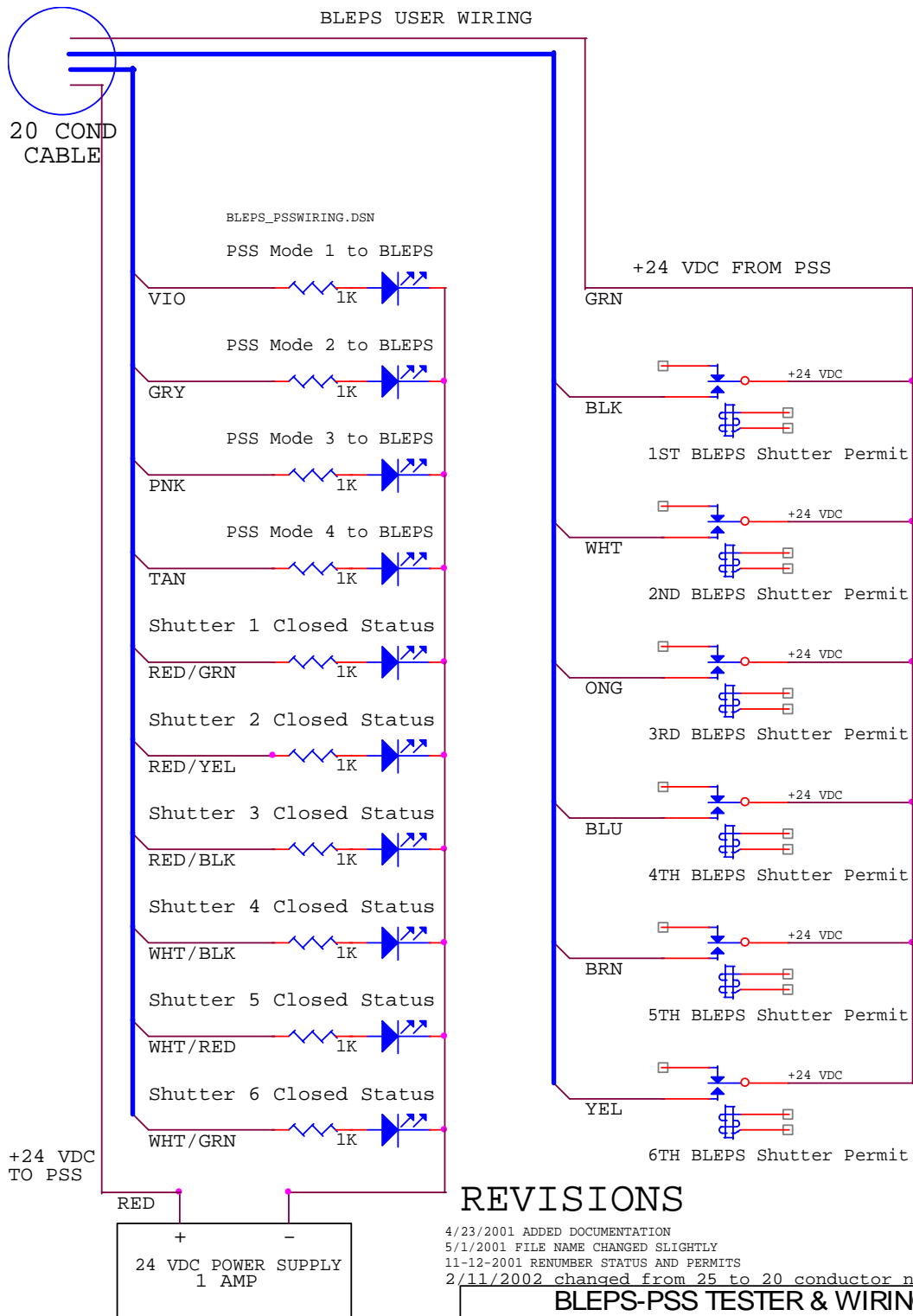
Fig 3. The WAGO Connectors

The WAGO connectors at the User end of the BLEPS interface cable. (This standard was instituted in 2001, for either BLEPS version 1 or 2). PSS supplies these socket connectors. Typical mates to this connector include WAGO plug 231-612/019-000), which can be supplied to User by PSS upon request.



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Fig 4. BLEPS VERSION 1 USER WIRING (used before Nov 2001).



REVISIONS

4/23/2001 ADDED DOCUMENTATION
 5/1/2001 FILE NAME CHANGED SLIGHTLY
 11-12-2001 RENUMBER STATUS AND PERMITS
 2/11/2002 changed from 25 to 20 conductor notation

| BLEPS-PSS TESTER & WIRING | | | |
|-----------------------------|---------------------------|-------|-----------|
| Title | | | |
| BLEPS PSS WIRING USER-A.DSN | | | |
| Size | Document Number | Rev | {RevCode} |
| B | {Doc} | | |
| Date: | Monday, February 11, 2002 | Sheet | 1 of 1 |

Fig 5. BLEPS Version 2 User Wiring. This wiring is used by Users for beamline interfaces after Nov. 2001.

